UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,414,416 B2
APPLICATION NO. : 10/506518
DATED : August 19, 2008
INVENTOR(S) : Watkins, Jr. et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

The title page, showing an illustrative figure, should be deleted and substitute therefor the attached title page.

Formal drawings (Sheets 1-8), attached, replace informal drawings (Sheets 1-8) as issued.

Signed and Sealed this

Twenty-ninth Day of June, 2010

David J. Kappos

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Director of the United States Patent and Trademark Office

(12) **United States Patent**
Watkins, Jr. et al.

(10) **Patent No.: US 7,414,416 B2**
(45) **Date of Patent: Aug. 19, 2008**

(54) **ELECTRICAL CONDITION MONITORING METHOD FOR POLYMERS**

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(73) Assignee: **Polymer Aging Concepts Inc.**, Dahlonega, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 108 days.

(21) Appl. No.: **10/506,518**

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§ 371 (c)(1),
(2), (4) Date: **May 9, 2005**

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PCT Pub. Date: **Sep. 18, 2003**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/362,157, filed on Mar. 6, 2002.

(51) **Int. Cl.**

G01N 17/00	(2006.01)
G01N 33/44	(2006.01)
G01N 27/04	(2006.01)
G01N 27/20	(2006.01)
G01R 31/12	(2006.01)

(52) **U.S. Cl.** **324/693**; 73/866; 324/71.1; 324/543

(58) **Field of Classification Search** 73/865.9–866, 73/865.6, 786, 802; 324/543–544, 693, 691, 324/541, 555, 71.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,603,142	A		9/1971	Saylak et al.
4,520,341	A	*	5/1985	Miyoshi et al. 338/35
4,988,875	A	*	1/1991	Ortiz et al. 250/330
5,317,252	A	*	5/1994	Kranbuehl 324/71.1
5,432,435	A	*	7/1995	Strong et al. 324/71.1
5,789,665	A	*	8/1998	Voelker et al. 73/53.05
6,004,817	A	*	12/1999	Chamberlain et al. 436/56
6,037,180	A	*	3/2000	Yorkgitis et al. ..... 73/866 X

(Continued)

FOREIGN PATENT DOCUMENTS

JP	361044339 A		3/1986

(Continued)

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(74) *Attorney, Agent, or Firm*—Kenneth S. Watkins

(57) **ABSTRACT**

An electrical condition monitoring method utilizes measurement of electrical resistivity of an age sensor made of a conductive matrix or composite disposed in a polymeric structure such as an electrical cable. The conductive matrix comprises a base polymer and conductive filler. The method includes communicating the resistivity to a measuring instrument and correlating resistivity of the conductive matrix of the polymeric structure with resistivity of an accelerated-aged conductive composite.

45 Claims, 8 Drawing Sheets

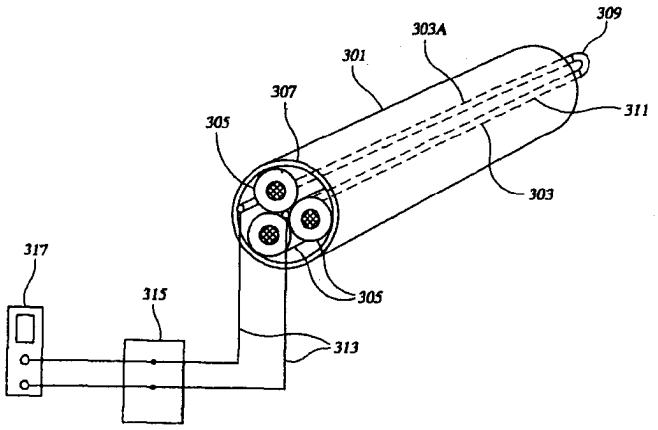


FIG. 1A

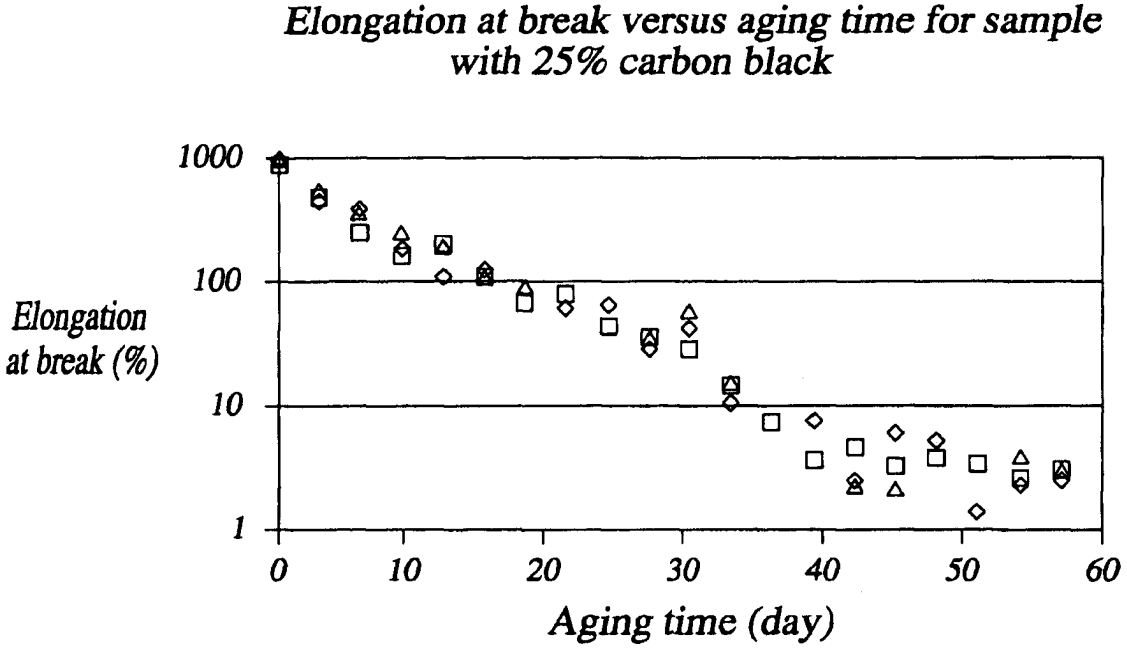
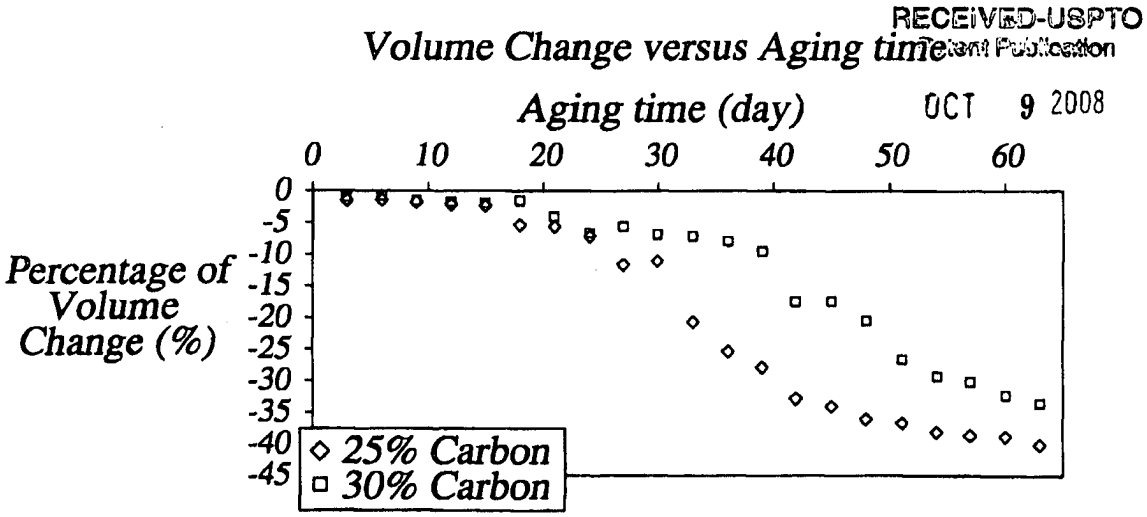

Elongation at break versus aging time for sample with 25% carbon black
1000
100
10
1
Elongation at break (%)
0
10
20
30
40
50
60
Aging time (day)

FIG. 1B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Volume Change versus Aging time
Aging time (day)
0
10
20
30
40
50
60
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
Percentage of Volume Change (%)
25% Carbon
30% Carbon

FIG. 1C

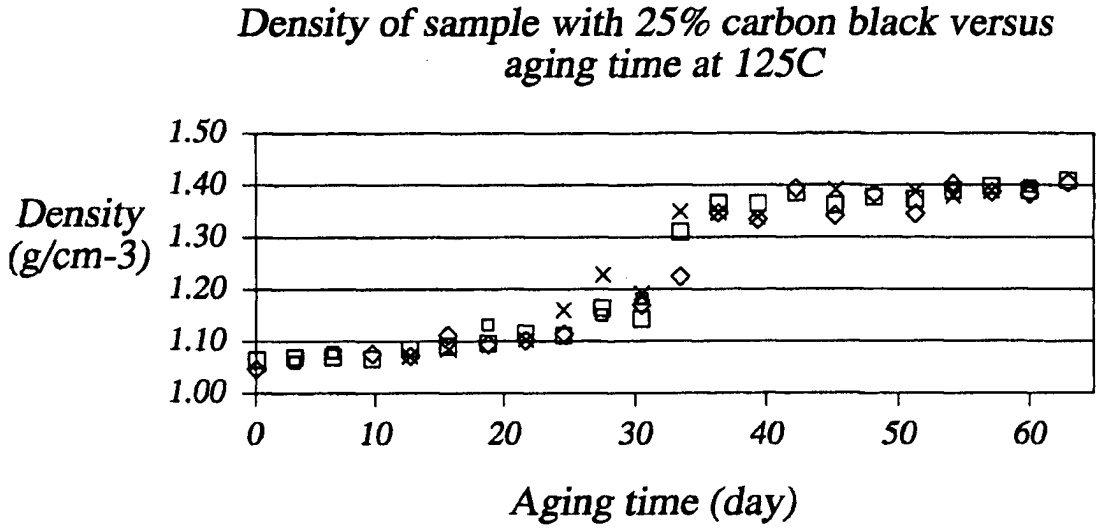

Density of sample with 25% carbon black versus aging time at 125C
Density (g/cm-3)
1.50
1.40
1.30
1.20
1.10
1.00
0
10
20
30
40
50
60
Aging time (day)

FIG. 1D

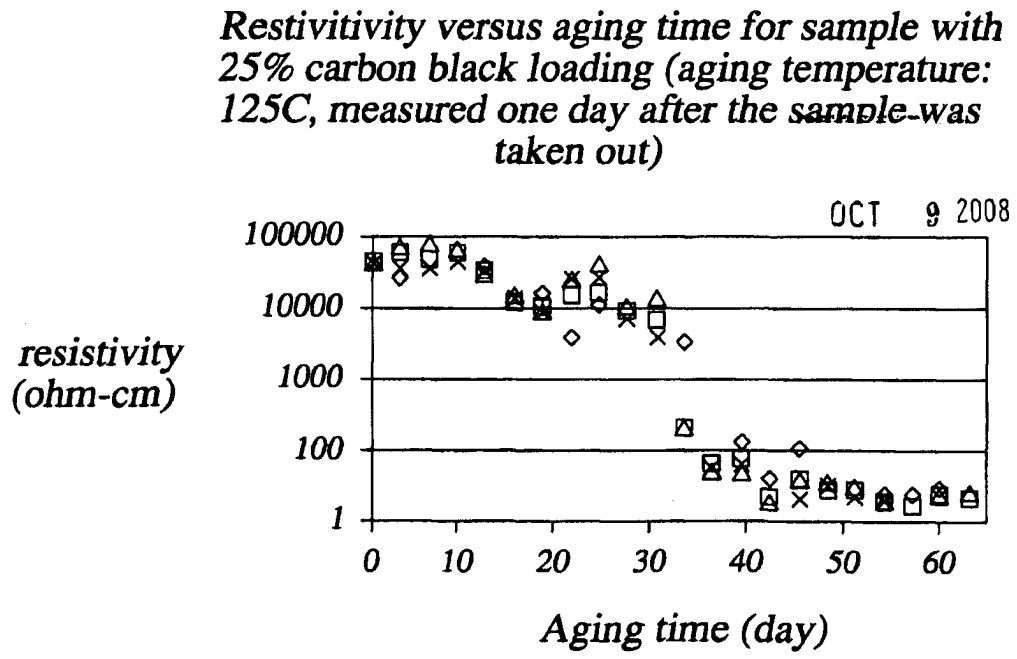

Restivitivity versus aging time for sample with 25% carbon black loading (aging temperature: 125C, measured one day after the sample was taken out)
OCT 9 2008
resistivity (ohm-cm)
100000
10000
1000
100
1
0
10
20
30
40
50
60
Aging time (day)

FIG.2A

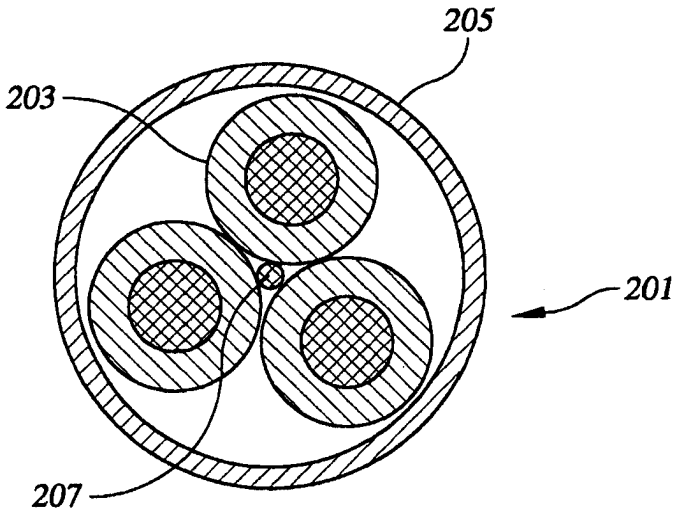
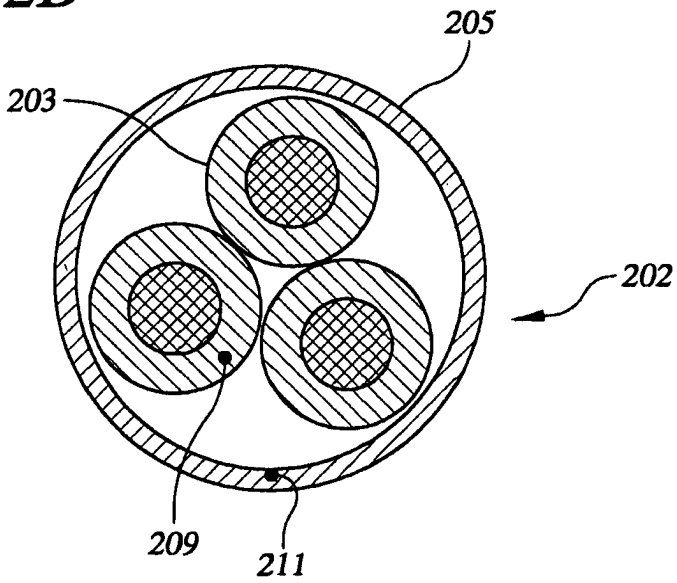


FIG.2B



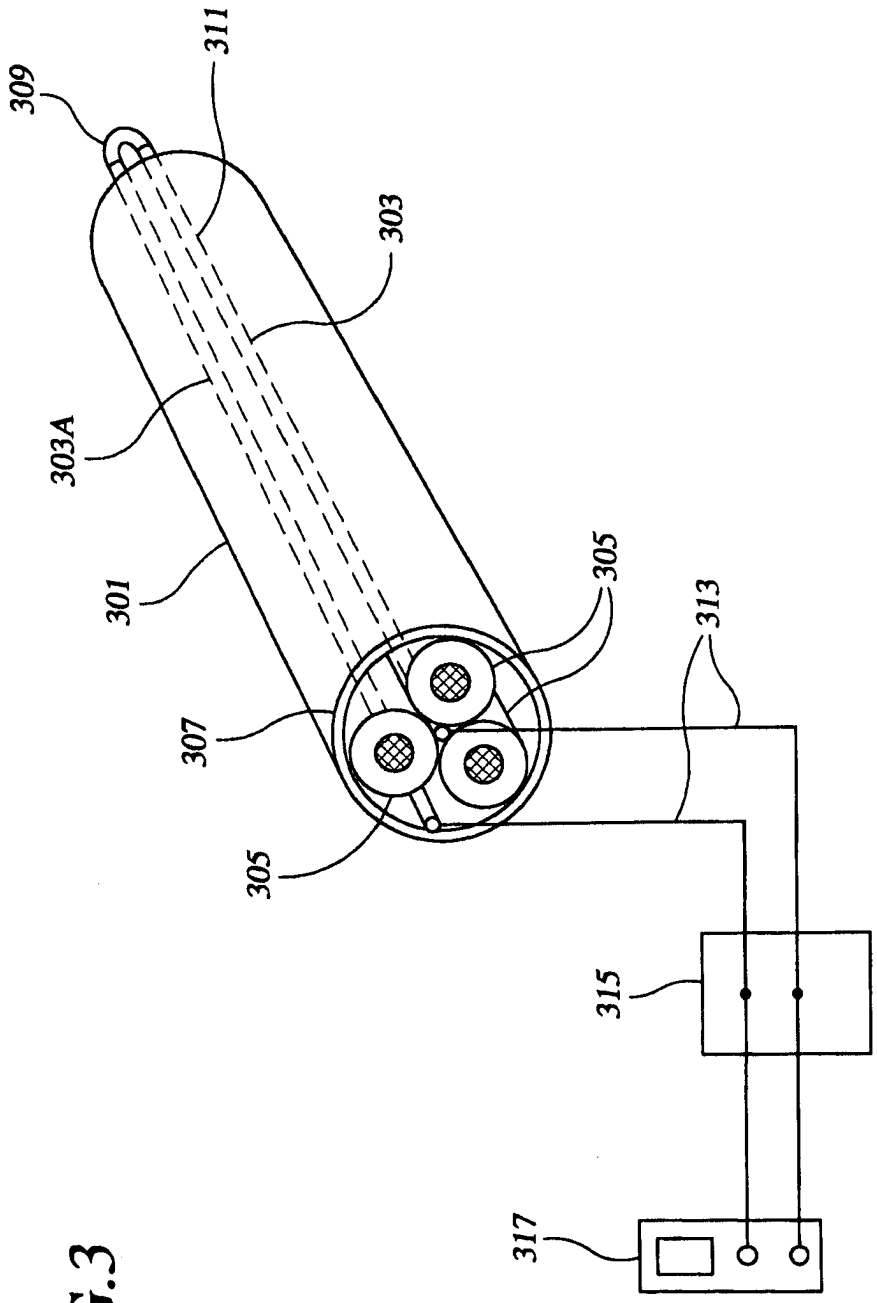


FIG.3

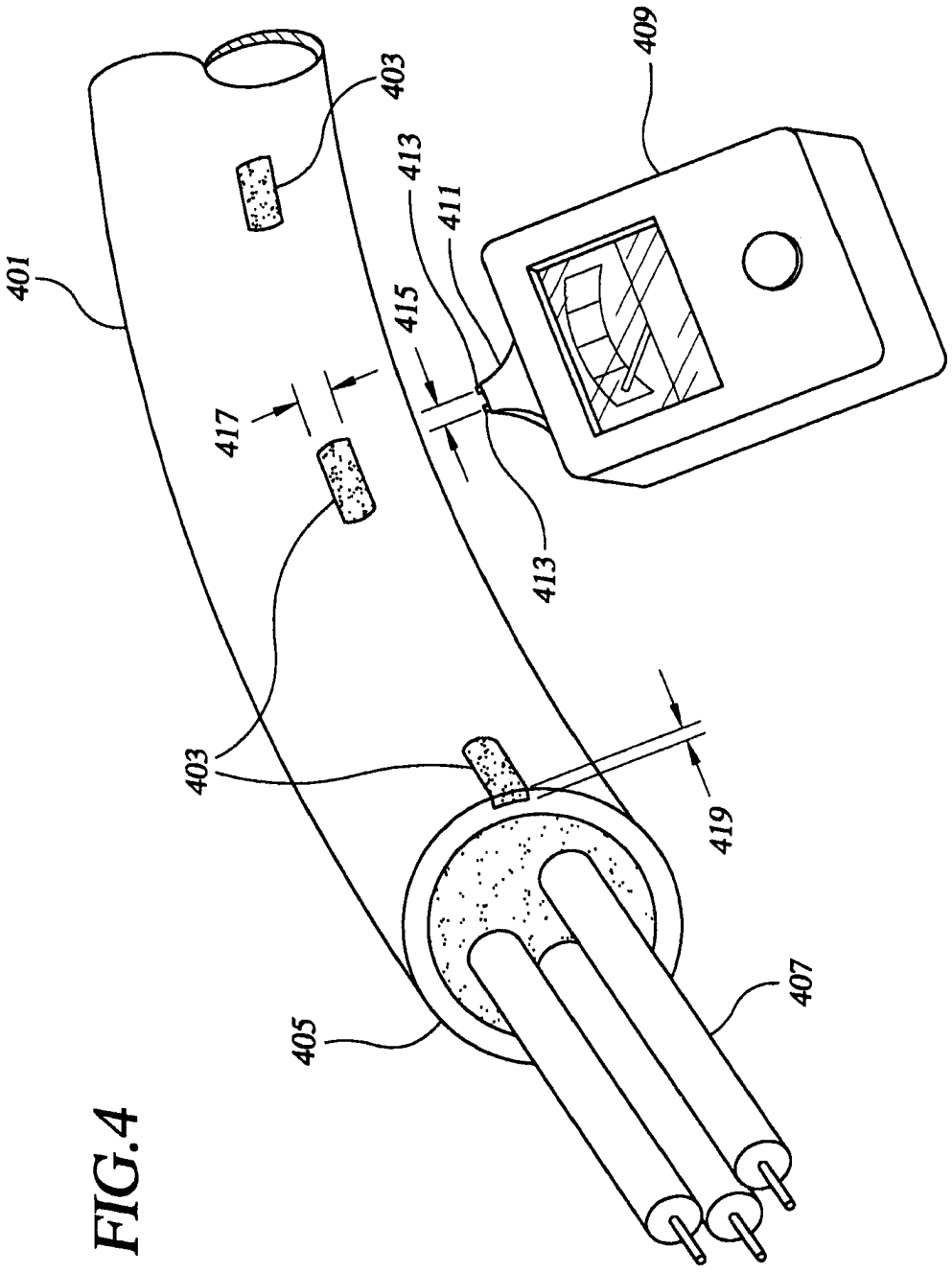


FIG.4

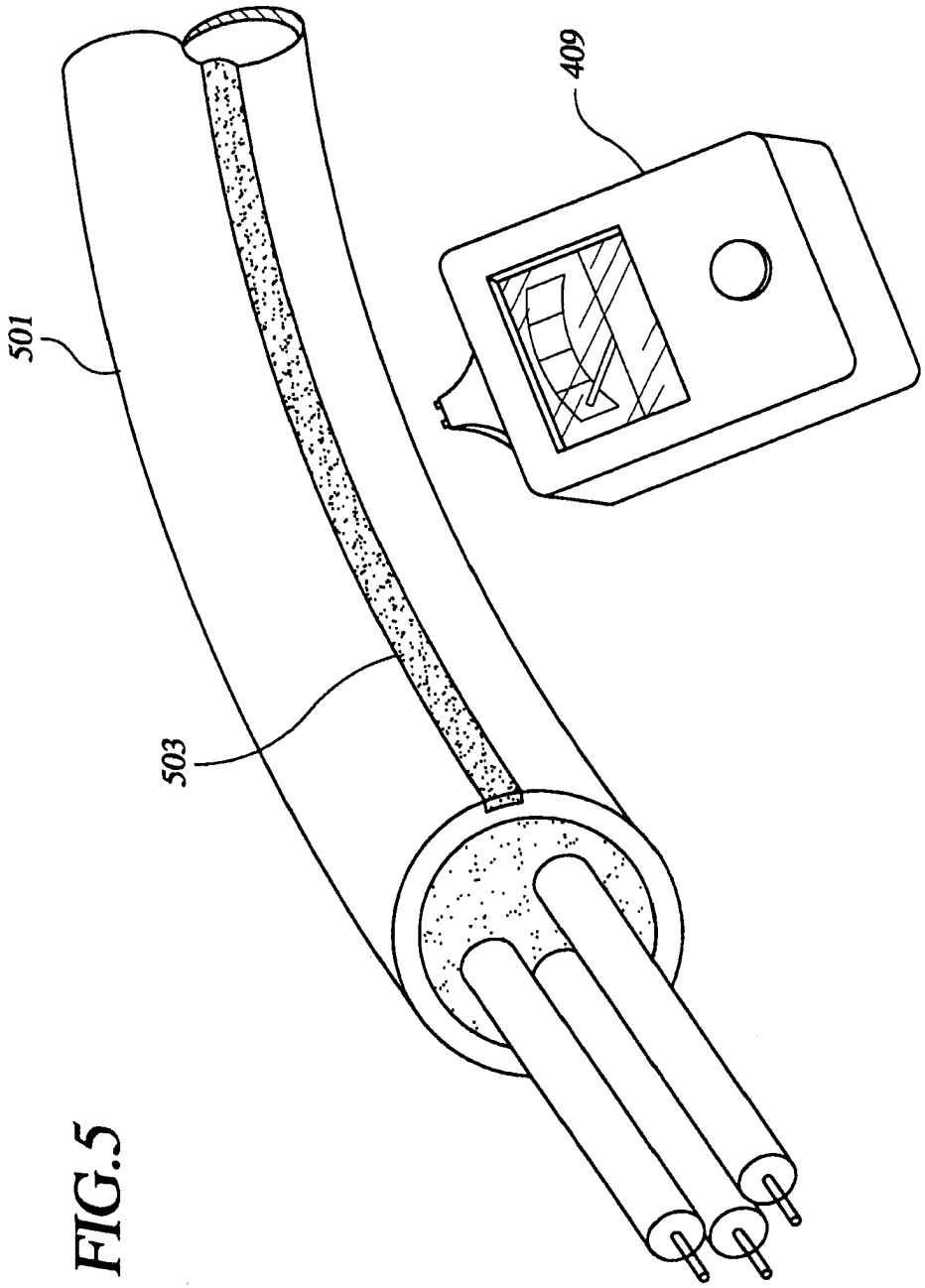


FIG.5

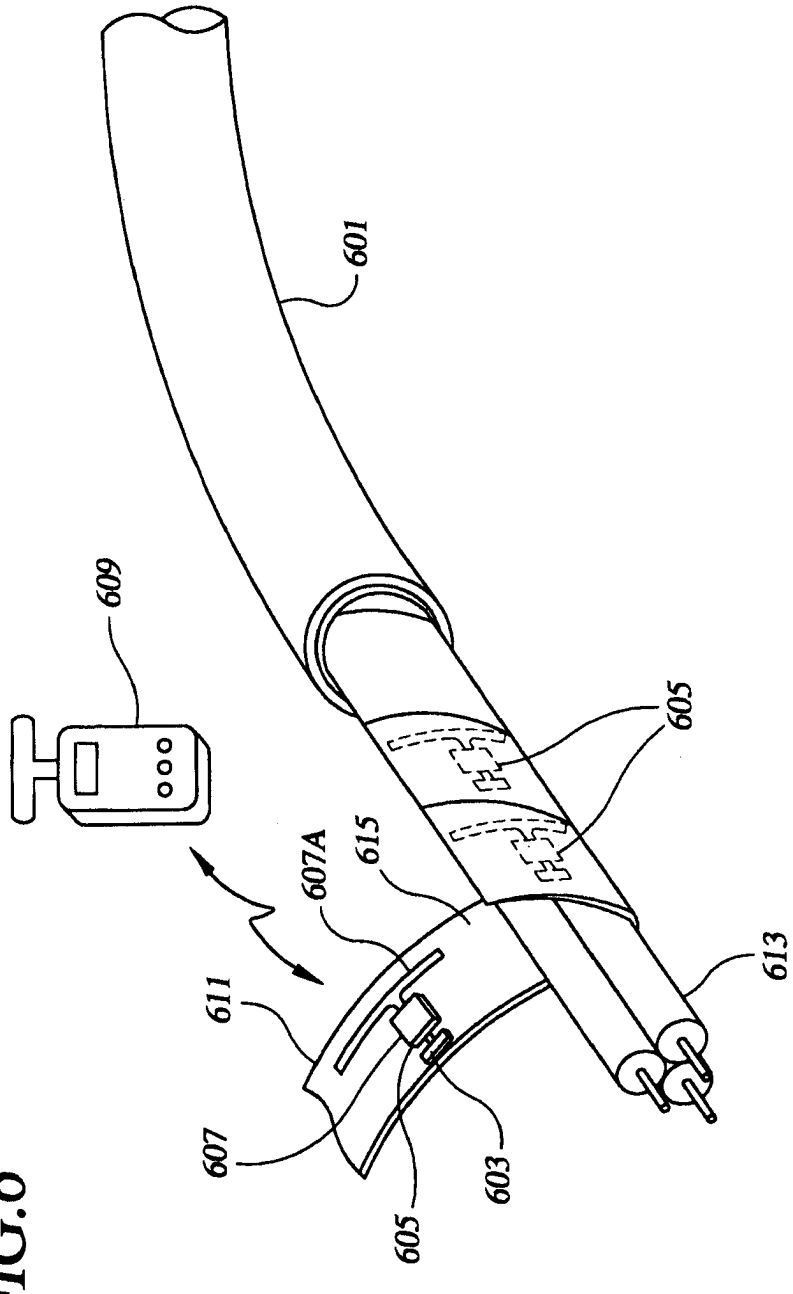


FIG.6

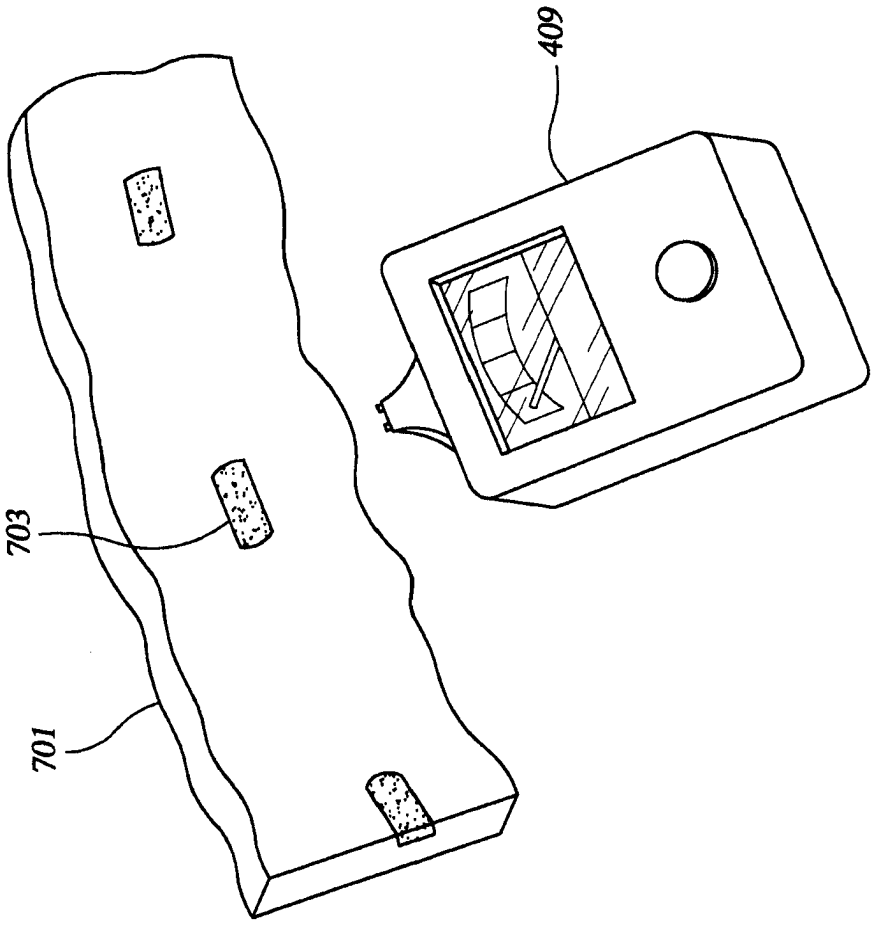


FIG.7